

ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal;

a pair of electrodes coupled to the magnetoresistance effect film and having respective inner edges; and

a pair of longitudinal biasing layers for providing bias magnetic fields to the first ferromagnetic layer in parallel with a longitudinal direction of the first ferromagnetic layer and having respective inner edges, said inner edges of the pair of electrodes being disposed between the inner edges of the pair of longitudinal biasing layers.

30. (Amended) A magnetoresistance effect element, comprising:

a nonmagnetic spacer layer;

first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, a magnetoresistance effect-improving layer comprising a plurality of metal films and disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic spacer layer and the magnetoresistance effect-improving layer, one of the plurality of metal films disposed in contact with the first ferromagnetic layer contains a metal element of not solid solution with a metal element of the first ferromagnetic layer; and

a nonmagnetic underlayer or a nonmagnetic protecting layer disposed in contact with the magnetoresistance effect-improving layer so that the magnetoresistance effect-improving layer is disposed between the first ferromagnetic layer and the nonmagnetic underlayer or the nonmagnetic protecting layer.

31. (Amended) A magnetoresistance effect head, comprising:

a magnetoresistance effect element including,

    a nonmagnetic spacer layer,

    first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, and

    a nonmagnetic high-conductivity layer disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic high-conductivity layer and the nonmagnetic spacer layer; and

    upper and lower magnetic shields sandwiching the magnetoresistance effect element through respective ones of upper and lower magnetic gaps.

32. (Amended) The magnetoresistance effect head of claim 31, wherein an average surface roughness of an upper surface of the lower magnetic gap is smaller than a thickness of the antiferromagnetically coupling film.

33. (Amended) The magnetoresistance effect head of claim 31, wherein a distance between a center of film thickness of the first ferromagnetic film and one of the upper and lower magnetic shields through the nonmagnetic high-conductivity layer is equal or smaller than a distance between the center of film thickness of the first ferromagnetic film and another one of the upper and lower magnetic shields through the second ferromagnetic film.

Please add new Claims 37-43 as follows:

37. (New) A recording/reproducing magnetic head, comprising:  
a substrate;  
a lower magnetic shield layer formed on a main surface of the substrate; and  
a magnetoresistance effect element formed on the lower magnetic shield layer,  
wherein the magnetoresistance effect element includes,  
a magnetoresistance effect film having a nonmagnetic spacer layer, and first and second ferromagnetic layers separated by the nonmagnetic spacer layer, a magnetization direction of the first ferromagnetic layer being at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic

field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal;

a pair of electrodes coupled to the magnetoresistance effect film and having respective inner edges; and

a pair of longitudinal biasing layers for providing bias magnetic fields to the first ferromagnetic layer in parallel with a longitudinal direction of the first ferromagnetic layer and having respective inner edges, said inner edges of the pair of electrodes being disposed between the inner edges of the pair of longitudinal biasing layers.

38. (New) A recording/reproducing magnetic head, comprising:

a substrate;

a lower magnetic shield layer formed on a main surface of the substrate; and

a magnetoresistance effect element formed on the lower magnetic shield layer,

wherein the magnetoresistance effect element includes,

a nonmagnetic spacer layer;

first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, a magnetoresistance effect-improving layer comprising a plurality of metal films and disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic spacer layer and the magnetoresistance effect-improving layer, one of the plurality of metal films disposed in contact with the first ferromagnetic layer contains a metal element of not solid solution with a metal element of the first ferromagnetic layer; and

a nonmagnetic underlayer or a nonmagnetic protecting layer disposed in contact with the magnetoresistance effect-improving layer so that the magnetoresistance effect-improving layer is disposed between the first ferromagnetic layer and the nonmagnetic underlayer or the nonmagnetic protecting layer.

39. (New) A magnetic storage system, comprising:

a recording/reproducing magnetic head including a substrate, a lower magnetic shield layer formed on a main surface of the substrate, and a magnetoresistance effect element formed on the lower magnetic shield layer,

wherein the magnetoresistance effect element includes a magnetoresistance effect film having a nonmagnetic spacer layer, and first and second ferromagnetic layers separated by the nonmagnetic spacer layer, a magnetization direction of the first ferromagnetic layer being at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, and

wherein the recording/reproducing magnetic head further includes,

a pair of electrodes coupled to the magnetoresistance effect film and having respective inner edges; and

a pair of longitudinal biasing layers for providing bias magnetic fields to the first ferromagnetic layer in parallel with a longitudinal direction of the first ferromagnetic layer

and having respective inner edges, said inner edges of the pair of electrodes being disposed between the inner edges of the pair of longitudinal biasing layers.

40. (New) A magnetic storage system, comprising:

a recording/reproducing magnetic head including a substrate, a lower magnetic shield layer formed on a main surface of the substrate, and a magnetoresistance effect element formed on the lower magnetic shield layer,

wherein the magnetoresistance effect element includes,

a nonmagnetic spacer layer;

first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal, a magnetoresistance effect-improving layer comprising a plurality of metal films and disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic spacer layer and the magnetoresistance effect-improving layer, one of the plurality of metal films disposed in contact with the first ferromagnetic layer contains a metal element of not solid solution with a metal element of the first ferromagnetic layer; and

a nonmagnetic underlayer or a nonmagnetic protecting layer disposed in contact with the magnetoresistance effect-improving layer so that the magnetoresistance effect-improving layer is disposed between the first ferromagnetic layer and the nonmagnetic underlayer or the nonmagnetic protecting layer.

41. (New) A magnetic storage system, comprising:

a recording/reproducing magnetic head including a substrate, a lower magnetic shield

layer formed on a main surface of the substrate, and a magnetoresistance effect element formed on the lower magnetic shield layer,

wherein the magnetoresistance effect element includes,

a nonmagnetic spacer layer;

first and second ferromagnetic layers separated by the nonmagnetic spacer layer, the first ferromagnetic layer having a magnetization direction at an angle relative to a magnetization direction of the second ferromagnetic layer at zero applied magnetic field, the second ferromagnetic layer comprising first and second ferromagnetic films antiferromagnetically coupled to one another and an antiferromagnetically coupling film located between and in contact with the first and second ferromagnetic films for coupling the first and second ferromagnetic films together antiferromagnetically so that their magnetizations are aligned antiparallel with one another and remain antiparallel in the presence of an applied magnetic field, the magnetization of the first ferromagnetic layer freely rotating in a magnetic field signal; and

a nonmagnetic high-conductivity layer disposed in contact with the first ferromagnetic layer so that the first ferromagnetic layer is disposed between the nonmagnetic high-conductivity layer and the nonmagnetic spacer layer, and wherein the magnetoresistance effect head further includes upper and lower magnetic shields sandwiching the magnetoresistance effect element through respective ones of upper and lower magnetic gaps.

42. (New) The magnetic storage system of claim 41, wherein an average surface roughness of an upper surface of the lower magnetic gap is smaller than a thickness of the antiferromagnetically coupling film.